VERIFICATION OF TRANSLATION

I, SUZUKI Ryokichi, a citizen of Japan, currently residing at 1-11-23-202, Hanazonominami, Nishinari-ku, Osaka-shi, Osaka, Japan, 557-0015, hereby declare:

That I am fully familiar with the English language and with the Japanese language in which the accompanying Japanese patent application No. 2003-113505 was prepared;

That the annexed English text is believed by me to be a true and accurate translation of the text of said Japanese patent application; and

That all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed at Osaka, Japan
Date: July 10, 2009

Signature: SUZUKI Ryokichi
SUZUKI Ryokichi

[TITLE OF DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION]

[CLAIMS]

[CLAIM 1]

A wireless communication device comprising:

a main body section including a display screen displaying a picture image;

a non-electromagnetically-shielded section on each of sides of the main body section, the sides being located laterally outside the display screen; and

an antenna in the non-electromagnetically-shielded section.

[CLAIM 2]

A wireless communication device comprising:

a main body section including a display screen displaying a picture image;

a ventilation section having a plurality of through-holes, the ventilation section being provided on a side of the main body section, the side being located outside the display screen; and

an antenna in the ventilation section.

[CLAIM 3]

The wireless communication device according to claim 1 or 2, further comprising:

a speaker storage section to each of left and right of the display screen,

wherein the antenna is provided in the speaker storage section.

[CLAIM 4]

The wireless communication device according to claim 3, wherein:

the antenna provided in the speaker storage section is a single antenna; and

the respective antennas are so installed as to have directions different from each other by 90 degrees.

[CLAIM 5]

The wireless communication device according to claim 4, wherein:

one of the respective antennas has directivity in a horizontal plane stronger than directivity in a vertical plane; and

the other of the respective antennas has directivity in the vertical plane stronger than directivity in the horizontal plane.

[CLAIM 6]

The wireless communication device according to any one of claims 1 to 5, wherein:

the antenna is either an inverted-L-shaped antenna

or an inverted-F-shaped antenna; and

the antenna is provided on each of left and right sides of the main body section such that the antenna on the left side has a shape identical with or different from a shape of the antenna on the right side.

[CLAIM 7]

The wireless communication device according to any one of claims 3 to 6, wherein the antenna is provided in the speaker storage section in such a manner as to protrude from a plane surface section on which a speaker is installed.

[CLAIM 8]

The wireless communication device according to any one of claims 1 to 7, wherein the antenna serves as a diversity antenna.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[INDUSTRIAL FIELD OF THE INVENTION]

The present invention relates to a wireless communication device installed so as to improve the receiving sensitivity of an antenna. The present invention is favorably applied to portable devices, such as a liquid crystal television device, an EL television device, a PDP

(Plasma Display Panel) television device, and a CRT (Cathode Ray Tube) television device, which can be carried around.

[0002]

[PRIOR ART]

In recent years, portable wireless communication devices, such as a liquid crystal television device and a CRT television device, which can be carried around, are proposed. Specifically, wireless communication devices for transmitting/receiving a video signal by employing an SS (Spread Spectrum) wireless system based on IEEE802.11 or IEEE802.11B are proposed. Moreover, for such wireless communication devices, not only the wireless system but also a system applicable to a next-generation cellular phone device whose speed of data transfer is increased, PHS (Personal Handy-Phone System) or Blue Tooth, is proposed.

[0003]

In such a wireless system, a receiving antenna is necessary. In general, an antenna length of an antenna element 12 for a frequency band of 2.4GHz is around three centimeters, which is equivalent to one quarter of a radio wavelength. Such an antenna is used in an SS wireless system, Blue Tooth wireless system and the like. Thus, an

antenna length of three centimeters is much shorter than an antenna length of an antenna element for frequency bands of VHF (Very High Frequency) and UHF (Ultra High Frequency) and the three-centimeter antenna is not required to have long shape such as a rod antenna. Nevertheless, no matter how short an antenna becomes, the antenna element may still protrudes in a noticeable manner in a portable wireless communication device such as a compact liquid crystal television device.

[0004]

In view of this, Patent Literature 1 discloses a liquid crystal television device having the following antenna structure: As illustrated in FIG.5, a liquid crystal television device 50 has an arrangement in which two antenna elements 53a and 53b are built in a handgrip section 52 attached to a cabinet 51. In this arrangement, the built-in antenna elements 53a and 53b are connected to screws 54a and 54b at both ends of the handgrip section 52, in a manner, parallel to each other. The arrangement makes it possible to have a diversity antenna structure constructed of the two antenna elements 53a and 53b.

[0005]

[Patent Literature 1] Japanese Unexamined Patent

Publication 261646/2002 (*Tokukai* 2002-261646)

[0006]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

However, in the art disclosed in Patent Literature 1 mentioned above, the antennas are built in the handgrip. Therefore, the positions in which the antennas are installed are on a rear side of the display section which is electromagnetically shielded. Accordingly, the sensitivity for receiving the electric wave coming from the front side of the display screen is problematically poor. Moreover, because each of the antennas is built outside the main body of the display device, e.g., contact with an external object may problematically change the direction in which the antenna is pointed, or break the antenna.

[0007]

In order to eliminate directivity of reception by providing antennas in many directions, a space on which to arrange the antennas is necessary. Thus, providing the antennas inside the liquid crystal television device may be considered. However, when provided inside, the antennas are covered by an electromagnetic shield such as unnecessary radiation. Accordingly, this is inconvenient for the purpose of receiving an electromagnetic wave. Furthermore, there exist many components which act as

shields (a liquid crystal panel, wiring substrate, parts of the internal structure and the like) that shield the electric wave to be received, in addition to the electromagnetic shield, inside the liquid crystal television device, and there has been a problem of these shields deteriorating the sensitivity for receiving an electric wave. Therefore, it has been difficult to provide the antennas inside the device.

[0008]

In view of this, an object of the present invention is to provide a wireless communication device having an antenna structure with improved communication sensitivity by being less influenced by the electromagnetic shield.

[0009]

[MEANS TO SOLVE THE PROBLEMS]

A wireless communication device of the present invention includes: a main body section including a display screen displaying a picture image; a non-electromagnetically-shielded section on each of sides of the main body section, the sides being located laterally outside the display screen; and antennas inside the non-electromagnetically-shielded section.

[0010]

Another wireless communication device includes: a main body section including a display screen displaying a picture image; a ventilation section having a plurality of through-holes, ventilation section being provided on a side of the main body section, the side being located outside the display screen; and antennas inside the ventilation section.

[0011]

Either of the above wireless communication devices may further include: speaker storage sections in both lateral directions from the display screen, wherein the antennas are provided inside the speaker storage sections. The foregoing wireless communication devices may further be arranged such that a single antenna is provided in each of the speaker storage sections; and respective antennas are so installed as to have directions different from each other by 90 degrees. The foregoing wireless communication devices may further be arranged such that one of the respective antennas has directivity in a horizontal plane stronger than directivity in a vertical plane; and the other of the respective antennas has directivity in the vertical plane stronger than directivity in the horizontal plane.

[0012]

Any of the above wirelcss communication devices may bc arranged such that the antennas are each either an inverted-L-shaped antenna or an inverted-F-shaped antenna; and the antennas are providcd on both lateral sides of the main body section such that the antennas have an identical shape or that the antennas have shapes different from each other.

[0013]

The above wireless communication deviccs may be arranged such that the antcnnas are provided in the speaker storage sections in such a manner as to each protrude from a plane surface section on which a speaker is installed.

[0014]

Any of the abovc wircless communication devices may be arranged such that the antennas serve as a diversity antenna.

[0015]

[EMBODIMENTS]

The present invention is explained below by an exemplary embodiment with reference to the drawings.

FIG.1 is a front view of a liquid crystal television device having a wireless communication device antenna structure according to the present invention, and FIG.2 is

a perspective view of the antenna structure. FIG.3 is an exploded perspective vicw of this liquid crystal television dcvice.

[0016]

As illustrated in FIG.1, this liquid crystal television device 10 includes a main body section 11 and semicircle speaker storage sections 12a and 12b provided on both left and right sides of the main body section 11. The speaker storage sections 12a and 12b are formed integrally with the main body 11. As illustratcd in FIG.3, exterior packages of this main body section 11 and the speaker storage sections 12a and 12b are made of a front cabinet 23 and a rear cabinet 24. The cabinets 23 and 24 contain parts therebetween and are fixed by a screw or the like. In the main body section 11, parts such as the liquid crystal panel section 13 are contained. The main body section 11 is provided with an electromagnetic shield so that an electromagnetic wave equal to or morc than a certain criterion does not leak outside. On an outer surface of the speaker storage sections 12a and 12b, sound emission openings 16a and 16b, which are through-holes to the inside, are formed. Inside thc speaker storage sections 12a and 12b, speakers 14a and 14b and antennas 15a and 15b are included. The speaker

storage sections 12a and 12b are not provided with an electromagnetic shield. Moreover, on a display surface side of the main body section 11, heat release openings 17, which are through-holes to the inside, are formed. The heat release openings 17 release heat from inside the main body section 11.

All of the sound emission openings 16a and 16b and the heat release openings 17 are ventilation sections that provide ventilation to the inside of the device.

[0017]

In this way, the antennas 15a and 15b are provided in the speaker storage sections 12a and 12b, which are not electromagnetically shielded. These speaker storage sections 12a and 12b are provided on external sides of the display screen of the display section 13 and in positions apart from the display section 13 that is electromagnetically shielded. Accordingly, an improved transmitting/receiving sensitivity can be maintained. Here, an external side of the display screen of the display section 13 is a side outside an edge section of the display screen of the display section 13, in any direction illustrated by the arrows in FIG.1.

[0018]

FIG.2 is a perspective view of a structure of the

antennas. FIG. 2(a) and 2(b) respectively illustrate an inverted L antenna and an inverted F antenna. The inverted L antenna 15 is made of a rectangular antenna substrate 21 and an antenna element section 22 made of a metal plate whose side surface is shaped in an inverted L. The inverted F antenna 26 is made of a rectangular antenna substrate 27 and an antenna element section 28 made of a metal plate whose side surface is shaped in an inverted F. Either type of antenna may be used. In this embodiment, the inverted L antenna is used.

[0019]

In the example illustrated by FIG.1 and FIG.3, the antennas 15a and 15b are provided respectively above the speakers 14a and 14b so as to have their directions of installation different from each other by 90 degrees. The antenna 15a has directivity in a horizontal plane stronger than directivity in a vertical plane and the other antenna 15b has the directivity in the vertical plane stronger than the directivity in the horizontal plane, in a state in which the antennas 15a and 15b are respectively provided in the speaker storage sections. According to the usage environment, the antennas 15a and 15b may be installed so as to face the same direction.

The antenna element section 22 is electrically

connected to the wireless transmitting/receiving circuit in the main body section 11. These two antennas 15a and 15b serve as a diversity antenna.

[0020]

FIG.4 is a block diagram of a wireless transmitting/receiving circuit.

The wireless transmitting/receiving circuit 30 includes a transmitting circuit section 31 for transmitting a wireless signal, a receiving circuit section 32 for receiving a wireless signal, a band pass filter (BPF) 34 for transmitting/receiving only a wireless signal within a frequency range to/from the antennas 15a and 15b, a changeover switch 33 for switching connections of the transmitting circuit section 31 and the receiving circuit section 32 to the BPF 34 temporally, and a diversity switch 35 for switching connections of the antennas 15a and 15b to the BPF 34 temporally. The diversity switch 35 is a time-share switch for connecting the wireless transmitting/receiving circuit section 30, by temporally switching, to the antennas 15a and 15b constituting the diversity antenna, using, for example, a micro computer (not illustrated).

[0021]

By this structure for connection, the BPF34 allows

only the wireless signals within the frequency band of the wireless signals used out of the wireless signals inputted into/outputted from the wireless transmitting/receiving circuit section 30 to pass through the BPF 34, thereby causing the antennas 15a and 15b to serve as a diversity antenna.

[0022]

The antennas 15a and 15b are stored in the speaker storage sections 12a and 12b that are provided on the outside of the main body section 11 covered by the electromagnetic shield. Moreover, the speaker storage sections 12a and 12b are not covered by the electromagnetic shield. This is advantageous in the respect of transmitting/receiving sensitivity. Moreover, in the speaker storage sections 12a and 12b, there are few electromagnetic shields such as a liquid crystal panel, substrate, and other parts. In this point, the above structure is also advantageous in the respect of transmitting/receiving sensitivity. Furthermore, compared with a case where antennas are stored in a handgrip as in the conventional art, a space for the storage sections can be ensured. Accordingly, the antennas 15a and 15b can be arranged so that the directions of the installation of these antennas are different from each other by 90 degrees. This

advantageously improves the transmitting/receiving sensitivity in all directions.

[0023]

One antenna is provided in each of the right and left speaker storage sections. However, the number of antennas provided may be plural. When two antennas are provided in each of the left and right speaker storage sections, for example, the directions of installation of the two antennas on each of left and right sides may be arranged to be different by 90 degrees. This can improve usability because a position of installation and a direction of the installation are not limited, in a case where the wireless communication device is used as a portable device.

[0024]

Moreover, the antennas are provided in directions different from each other by 90 degrees. However, the direction of the installation is not specifically limited to this. The direction of the installation may be determined so that the transmitting/receiving sensitivity in all directions becomes high. The antennas may be arranged so as to face the same direction. In this case, a width (depth) of a space in which the antennas are installed can be reduced. Accordingly, the antennas can be utilized in a

thin-model device such as a liquid crystal television without detracting from the feature of the device being thin. This embodiment is explained by an example in which the antennas are mounted on the liquid crystal television device. However, the device in which the antennas are mounted is not limited to this. For example, the present invention is preferably applied to portable devices, such as an EL television device, a PDP television device, and a CRT television device, which can be carried around.

[0025]

[EFFECTS OF THE INVENTION]

According to the present invention, the antennas are provided in non-electromagnetically shielded sections provided on the external sides of the display screen in the main body section, or, the antennas are provided while the ventilation sections are provided on the outside of the display screen in the main body section. Therefore, the antennas are not influenced by an electromagnetic shield. Accordingly, it is possible to better improve the communication sensitivity of the antennas. Moreover, because the antennas are not exposed to the outside of the main body of the display device, the problem of the direction of the antenna changing or the antenna breaking

upon, e.g., contact with an external object can be ameliorated.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

FIG.1 is a front view of a liquid crystal television device having a wireless communication device antenna structure according to the present invention.

[Fig. 2]

FIG.2 is a perspective view of the antenna structure. FIG. 2(a) and 2(b) respectively illustrate an inverted L antenna and an inverted F antenna.

[Fig. 3]

FIG.3 is an exploded perspective view of the liquid crystal television device.

[Fig. 4]

FIG.4 is a block diagram of a wireless transmitting/receiving circuit.

[Fig. 5]

FIG.5 is a rear view of an antenna structure in a conventional liquid crystal television device.

[REFERENCE NUMERALS]

10 Liquid crystal television device

11 Main body section

12a, 12b Speaker storage section

13 Liquid crystal panel section

14a, 14b Speaker

15a, 15b Antenna

21, 27 Antenna substrate

22, 28 Antenna element section

23 Front cabinet

24 Rear cabinet

30 Wireless transmitting/receiving circuit

31 Transmitting circuit section

32 Receiving circuit section

33 Changeover switch

34 Band pass filter

35 Diversity switch

[TITLE OF THE DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT] To provide a wireless communication device having an antenna structure for improvement in the transmitting/receiving sensitivity in all directions.

[MEANS TO ACHIEVE THE OBJECT] Exterior packages of the main body section 11 and the speaker storage sections 12a and 12b are made of the front cabinet 23 and the rear cabinet 24. The cabinets 23 and 24 contain parts therebetween and are fixed by a screw or the like. In the main body section 11, parts such as the liquid crystal panel section 13 are contained. The main body section 11 is provided with an electromagnetic shield so that an electromagnetic wave equal to or more than a certain criterion does not leak outside. Inside the speaker storage sections 12a and 12b, speakers 14a and 14b and antennas 15a and 15b are included. The speaker storage sections 12a and 12b are not provided with an electromagnetic shield. The antennas 15a and 15b are provided respectively above the speakers 14a and 14b so as to have their directions of installation different from each other by 90 degrees.

[SELECTED DRAWINGS] Fig. 1